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KINDERHOOK STRATIGRAPHY

At frequent intervals during the past decade, there have appeared notes on certain beds, occurring in different parts of the Mississippi valley, which have passed under the general name of Kinderhook. For the most part these notes have dealt with local phenomena. In the present connection attention is called briefly to some problems of broader significance.

Along the upper Mississippi River the formations immediately underlying the great Burlington limestones are exposed chiefly in two localities. One is at Burlington, Iowa, and the other at Louisiana and Hannibal, Missouri, and at Kinderhook, Illinois, which is only a few miles from the last named place. Between the two localities the distance is 125 miles. In this distance a shallow syncline carries down the Kinderhook beds 200 feet below the level of the stream.

The early investigations of this Burlington-Louisiana section were carried on simultaneously at the two ends, but by different persons. When the time came to parallel in detail the vertical sections at the extremes difficulties arose. The various beds could not be traced from one point to another because, for most of the distance, the strata were not open to inspection. The method of correlation by visible continuity was inapplicable. Comparison by similar lithologic sequence was likewise unsatisfactory, because the sections were so very different, and it was impossible to tell when or in what manner the changes took place.

When the fossils of the two localities were compared, the results were singularly futile, so far as throwing light upon the problem of exact stratigraphic equivalency. The organic forms were unequally distributed. A large part of both sections had yielded no fossil remains at all. In the northern locality the known animal remains had been found chiefly at the very top of the section; in the southern, at the very bottom. As to the exact horizons of their occurrence the literature usually gave small clew. With most of the forms no comparison was possible, for the facies of the two faunas were of very different types. After an elapse of 30 years the question of the geological age of the various beds presented itself as formidably as when first these rocks were brought into notice.

Of late years a number of deep wells have been drilled along the upper Mississippi River. These have enabled various geological sections exposed at points far removed from one another to be connected with a degree of confidence never before attained. In the Louisiana-Burlington cross-section, wells at Hannibal, La Grange, Keokuk, Burlington and other points have disclosed important features. These purely stratigraphical features are of particular interest at the present time because of their bearing upon the lack of geological integrity of the typical Kinderhook.

On all of the problems mentioned, the data derived from the deep-well sections have an important bearing. Furthermore, it is pointed out just along what lines critical evidence is to be sought.

A few years ago the geological sections at the type localities of the several parts making up the Mississippian series of the Carboniferous, were personally studied in order to find out from first hands just what each really meant.[1] Among these sections were those found in the vicinity of Kinderhook, Illinois, which were the basis of what had been long considered the lowermost member of the Carboniferous system, and had been widely known as the Kinderhook formation. Hannibal and Louisiana, Missouri, which are not far away, exhibited the same rocks even to better advantage, and therefore were regarded in all respects as essentially typical.

As is well known, the typical Kinderhook has been regarded as consisting of three members: A basal Louisiana limestone, a median Hannibal shale, and a capping Chouteau limestone.

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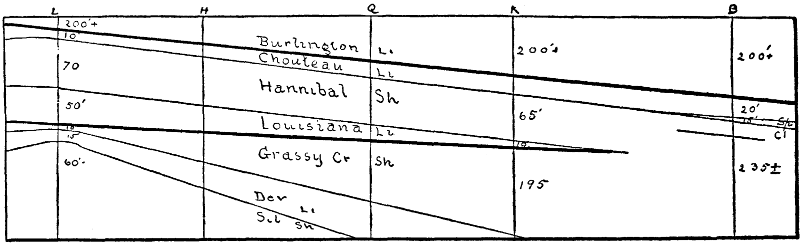
[1] Principal Mississippian Section; Bull. Geol. Soc. America, Vol. III, pp. 283-300, 1892.

These three members retain their lithological characteristics over broad areas, the extent of which is surprising. The distances of continuity are so great that ordinarily doubt would be cast upon this assumption were it not for the fact that all observations are easily checked by the overlying Burlington limestone. While the lithological features of the several parts of the Kinderhook are so persistent, the faunas contained appear to be remarkably local in nature. The existence of a large number of restricted faunas, in place of a general one is probably the chief cause for past failures to correlate, by the biotic method, the various sections of the Kinderhook.

The stratigraphical relationships of the Burlington and Louisiana sections at last appear to be indicated by the aid of the deep wells drilled between the two points. These relationships are best expressed by the following diagrammatic cross-section, in which, however, while drawn to a scale, no allowance is made for the synclinal attitude of the strata. What has been regarded as the typical Kinderhook formation is included between the heavy lines.



Immediately beneath the Louisiana limestone, the basal member of the Kinderhook at Louisiana and vicinity, is the Black shale of the Devonian, according to Meek and Worthen.[1] In the neighborhood of Louisiana it has been called the Grassy Creek shale.[2] While at the town itself it only has a thickness of about six feet, and thins out completely to the south, it is 30 feet thick on Grassy Creek, a few miles to the west. Northward, this shale bed grows rapidly in thickness, until at Keokuk it reaches 195 feet.

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[1] American Jour. Sci. (II), Vol. XXXII, p. 228, 1861.

[2] Proc. Iowa Acad. Sci., Vol. V, p. 63, 1898.

The Louisiana limestone, which is over 50 feet thick at the type locality, appears to get thinner northward. At Keokuk it is only 10 feet in thickness, and seemingly fails altogether before Burlington is reached. Its southern extension is not known. It is not believed to be as extensive as Missouri geologists have generally supposed. The Lithographic limestone of southwestern Missouri is not thought to be the same. The apparent fading out towards the north is not an unusual phenomenon among the limestones of the region. Similar cases are known in the Missourian series, or Upper Coal Measures, farther west.[1]

At Louisiana and Hannibal, the shales bearing the latter name have a thickness of about 70 feet. This thickness is maintained northward at least as far as Keokuk, as deep wells show. Beyond this point at Burlington a very similar shale, appears in the base of the river bluffs, having a thickness, including the upper sandy portion (Chonopectus sandstone of Weller[2]), of 85 feet, above the river level. Shale is known to extend downward at least 150 feet more, making a total measurement, from the top of the Chonopectus sandstone, of 235 feet.

The question has arisen as to how much of the Burlington section[3] can be regarded as representing the Hannibal shale. On fancied lithologic grounds solely it was early suggested by Worthen[4] and White[5] that the earthy fragmentary limestone, 15 to 18 feet thick, overlying the lower "yellow sandstone" (the Chonopectus bed) was the northern extention of the lithographic (Louisiana) limestone of Missouri. This view has been recently again alluded to by Weller.[6] If this were the case all of the Burlington section below the top of the Chonopectus sandstone would be beneath the horizon of the Louisiana limestone.[1]

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[1] Proc. Iowa Acad. Sci., Vol. VII, 1900.

[2] Trans. Acad. Sci., St.Louis, Vol. X, p. 57, 1900.

[3] Full detailed descriptions of the various sections here referred to will be found in the lately issued volumes of the Iowa and Missouri geological surveys.

[4] Geology Iowa, Vol. I, p. 206, 1858.

[5] Boston Jour. Nat. Hist., Vol. VII, p. 212, 1860.

[6] Trans. Acad. Sci., St. Louis, Vol. X, p. 123 1900.

In the recent Iowa[2] and Missouri[3] reports the basal shale as exposed above river level at Burlington was considered as about the equivalent of the Hannibal shale. At the same time it was surmised that this part of the section at Burlington probably rested directly upon certain shales found farther north, and which were commonly regarded as belonging to the Devonian. This, however, was merely a working hypothesis; and opportunity did not present itself to carry out very far the necessary field investigation to either prove or disprove it.

On this supposition the 235 feet of shale, of which about one third is above the river level at Burlington, would represent not only the Hannibal shale, but in its lower unexposed part, a so-called Devonian shale as well. The recent discovery of a rich fauna[4] considered as composed of typical Devonian types gives strength to this idea. Still later Weller[5] gives expression to something of the same conception when he states regarding the occurrence of the Hannibal shales in Iowa, that it is "probable that the section at Burlington is equivalent, or more than equivalent, to the whole of the section as known in Missouri." If we take into consideration the 150 feet of shales below water level the stratigraphic evidence now presented goes far towards proving the statement.

The deep-well sections give no indication that the Hannibal shales, as they are known at the type locality, change materially either stratigraphically or lithologically from Louisiana to Keokuk. There is yet no reason whatever for imagining that they should abruptly thin out entirely between Keokuk and Burlington.

[1] Iowa Geol. Sur., Vol. X, p. 79, 1900.

[2] Iowa Geol. Surv., Vol. I, p. 55, 1893.

[3] Missouri Geol. Surv., Vol. IV, p. 56, 1894.

[4] Proc. Iowa Acad. Sci., Vol. IV, p. 39. 1897.

[5] Trans. Acad. Sci., St. Louis, Vol. X, p. 123, 1900.

One the other hand, all evidence goes to show that the Louisiana limestone gradually becomes thinner as the distance increases from the type locality northward, until at Keokuk it is less than one fifth of its original thickness. Everything indicates that it has faded out completely long before the city of Burlington is reached. If the Hannibal shales have retained anything of their normal thickness, as they have in the long distance from Louisiana to Keokuk, the horizon of the Louisiana limestone would be expected to be not far above the river level at Burlington. No bed at or near this horizon has been found that would correspond in lithological or any other of the characters of the Louisiana formation. The only layer of the whole Burlington section below the base of the Burlington limestone, that at all resembles the Louisiana is the Productal limestone (No. 3 of Keyes, No. 4 of Weller), with a coralline zone at the base (No. 3 of Weller), and overlying the Chonopectus sandstone. The lithologial characters of the two are only remotedly related. There are strong stratigraphic reasons, however, for connecting this stratum, as well as those above it, up to the Burlington limestone, with the Kinderhook limestones still farther north at LeGrand, in Marshall county, Iowa. Still other grounds exist for believing the Productal zone at Burlington to be the attenuated margin of LeGrand beds.[1]

All the stratigraphic evidence, as disclosed by the Mississippi River cross-section, the deep wells along the course, and the general geological features of the region appear to indicate, beyond much doubt, that the Louisiana limestone actually does become attenuated northward from the type locality, and that the underlying Grassy Creek shales and the overlying Hannibal shales merge north of Keokuk. If this be the correct interpretation, the section at Burlington, below the top of the Chonopectus sandstone, including over 100 feet of shales beneath the river level, represents considerably more than the Hannibal shales of Missouri.

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[1] There is, therefore, apparently little possibility of the Productal limestone representing anything other than the Chouteau beds as exposed farther south.

The Chouteau limestone, which finds its typical development in central Missouri, appears to be well represented, in the northeastern part of the state where the typical Kinderhook is shown, by 10 feet or more of massive earthy limestone, that is fine grained and contains comparatively few fossils. It is sufficiently distinctive in lithological characters to be readily recognizable in deep-well drillings. At Keokuk, it is over 20 feet thick, and at Burlington, if we consider the interval between the Chonopectus sandstone and the Burlington limestone as representing it, about 30 feet thick. In central Iowa it is believed to be represented by the LeGrand limestone, and is over 100 feet thick, there being about the same development as in central Missouri.

The lithologic features at Burlington, while differing from those farther south and at the type locality in central Missouri, correspond very closely with the characters presented northward. At Burlington, also, it is still chiefly limestone. Here it consists of a thin basal coralline zone, the Productal limestone, the Spirifer sandstone, the Gyroceras oolite and the brown Rhodocrinus limestone. These, however, are local collectors' names, and it is not known how far these distinctions should be really recognized.

Independent of the purely stratigraphical characters of the Kinderhook, as exposed along the Mississippi River, there are certain faunal features of the formation that are not without interest. Until now, all correlations of the Kinderhook beds have had to be inferred from imperfect fossil data. Moreover, the information has been so inexact for present requirements, that the fossils have to be studied largely anew in order to find out in just what layers the various forms occur. Only in this way can useful and exact comparisons of the faunas be made.

Already Weller has begun, along the lines indicated, a series of "Kinderhook Faunal Studies." Judging from the two installments already issued it is expected that there will soon be available much of the long desired information concerning the exact stratigraphic range of the fossils, and the relationships of the various biotic groups.

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